Space Weather Technical Forecast

Issued on Friday, 15 April 2022 at 13:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor geomagnetic storms possible at first on day 1 (15th) due to CME affects, and more likely later on day 2 (16th) due to HSS.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with an M2 flare observed to have commenced at 15/1052 UTC. There are signs of increasing activity as potential regions from the far side approach, and this appears to be the source. There are three sunspot regions on the visible disc, with the most developmental AR2990 Dso/Beta, with a further uni-bipolar region following AR2989 Hrx/Alpha. AR2991 Hsx/alpha so far appears to be a mature and stable region that has recently rotated onto the southwest disc. No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was observed to be slightly elevated to elevated and the expected CME from the filament eruption on the 11th arrived around 14/1230 UTC, and this increased the solar wind to around 575 km/s. The density was average to above average, peaking at 15 ppcc. The interplanetary magnetic field (IMF) strength Bt, was observed to be at moderate to strong levels following the CME, reaching a peak value of 22 nT. The north-south component Bz, was predominantly negative, reaching -13 nT at times. The phi angle has fluctuated but ended the period in a mostly negative (towards the sun) orientation. This resulted in G1/Minor Storm intervals observed 14/1800-2100 UTC and 15/0000-0300 UTC. Between 14/1500-1800 UTC a G2/Moderate geomagnetic storm intervals was observed.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES-16 at GEO was at background levels. The high energy electron flux (greater than 2 MeV) was normal background to Moderate, peaking at 476 pfu at 15/0440 UTC. T. The associated 24 hour electron fluence has been below the Active threshold throughout, but now with a rising trend in recent hours, with observed fluence of 5.18e6 integrated pfu by GOES-16 at 15/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate. The three sunspot regions on the disc are small, and only showing limited growth, however activity from the far-side is approaching the eastern limb with M-class flares increasingly likely to affect Earth.

Solar Wind / Geomagnetic Activity: Earth is within the magnetic cloud from the CME which left the Sun on the 11th, with ongoing affects forecast to persist for the remainder of day 1 (15th). Solar winds are forecast to decline before a further enhancement from the arrival of the fast wind of CH75/+ is forecast later on day 2 or early on day 3 (16th-17th), although this is low confidence. No further CME arrivals are expected. Geomagnetic activity is forecast to be mostly Quiet to Unsettled, becoming Active to G1/Minor Storm at first and again on arrival of the faster solar winds, most likely later day 2 (16th) or day 3 (17th). By day 4 (17th-18th) a return to mainly

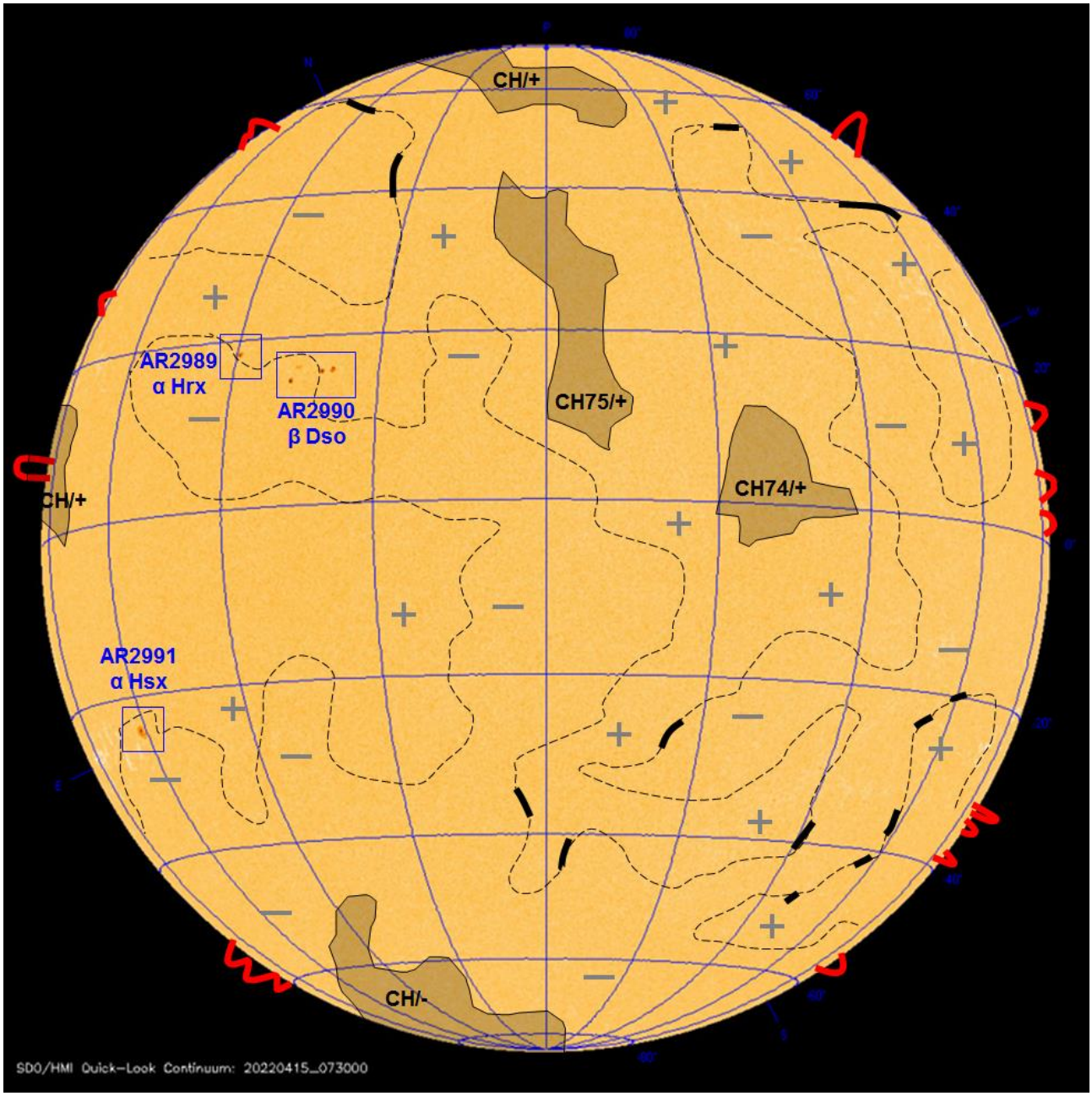
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Quiet conditions is likely.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to persist at background levels. High energy electron flux (greater than 2 MeV) is likely to reach Moderate levels, perhaps peaking at High from Day 2 (16 April;) onwards, although a temporary drop-out is likely on arrival of the HSS later on Day 2 (16 April). The associated 24 hour electron fluence starting below the Active (1e8 integrated pfu) threshold with a chance of approaching the active threshold by day 4 (18 April).

Figure 1. Solar Analysis Valid 0800 UTC, 15 April 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

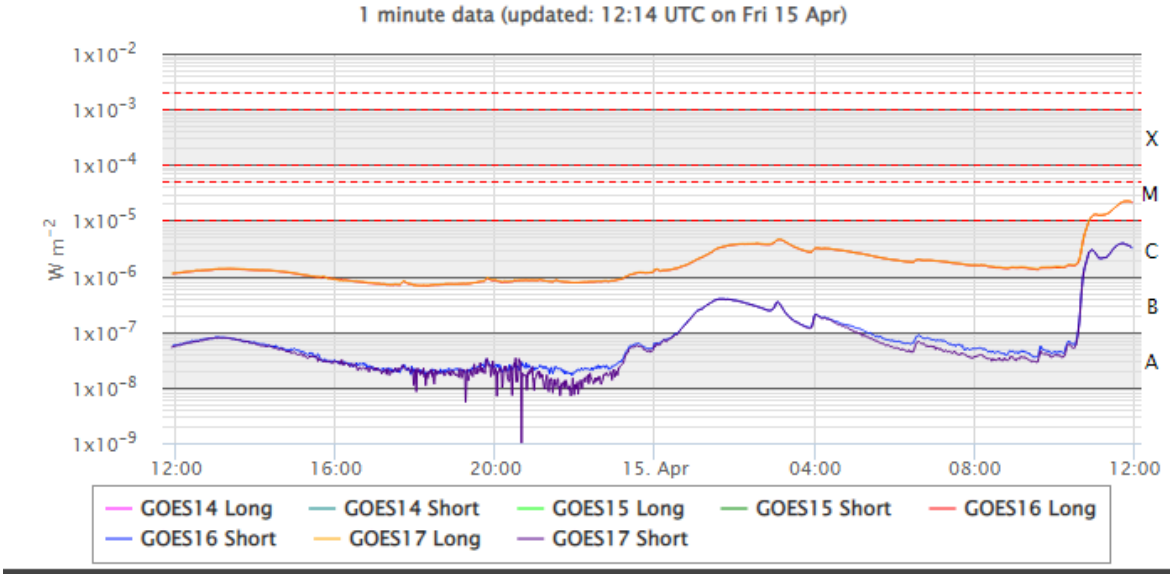
The anticipated CME from the 11th has arrived around 14/1230 UTC . The solar wind is likely to decline day 1 into day 2 (15th-16th) , before the arrival of the HSS related to positive polarity CH74 later on day 2 (16th). The timing and strength of this feature is low confidence, with a lack of a clear signal from STEREO A Mag and PLASTIC data, and also being new to this rotation, limiting the value of persistence. Furthermore, this is a positive coronal hole which is unfavoured for connection during spring (Russel-McPherron effect). Any enhanced solar winds are expected to gradually ease later day 3 into day 4 (16th-17th).
Geomagnetic activity is forecast to be mostly Quiet to Unsettled, becoming Active to G1/Minor Storm at first and again on arrival of the faster solar winds, most likely later day 2 (16th) or day 3 (17th). By day 4 (17th-18th) a return to mainly Quiet conditions is likely.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	80	30	20	5
Strong	G3	No	2	2	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: X-ray flux at GEO showing long duration C-class flares and recent M-Class flare.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

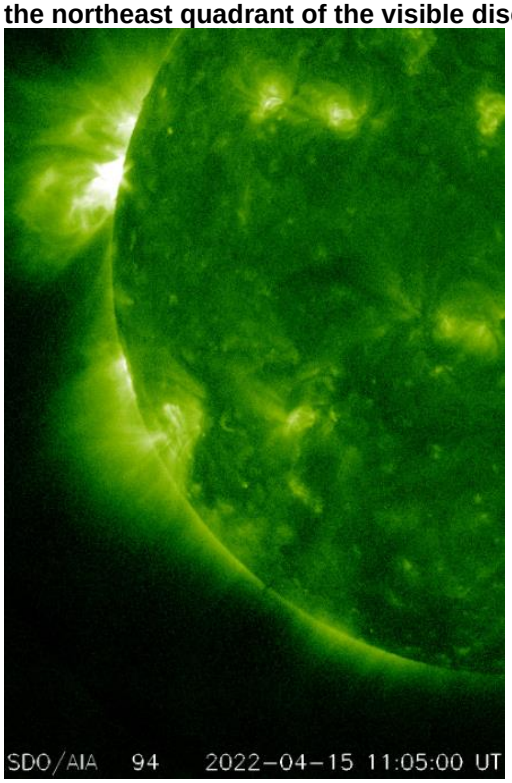
Radio Blackouts - X-Ray Flares:

There are three sunspot regions on the disc. Whilst these are all small, and relatively simple regions with solar activity currently Low, some slight growth in the intermediate spots has been evident in AR2990 Dso/Beta, AR2989 Hrx/alpha in the northeast and AR2991 Hsx/alpha in the southeast, both appear to be simple and stable.

The far-side remains active with recent CMEs observed, and a notable signature on far-sided products, including helioseismographs and the GONG far-side magnetograph. This corresponds to the area around Ex-AR2975 which has been traversing across the far-side, and is due back onto the east limb on the Earth-side late on day 3 (17th), and matches to a bright area of flux on visible on the STEREO A euvi-imagery. These far-side regions, alongside development on the near-side have led to background flux levels rising. Low to Moderate solar activity is therefore likely to continue this forecast period and an increase in M-class flares likely through the coming days as far-side regions approach the east limb, and this is reflected in the probabilities given in the table above.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	30	40	50
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: SDO –aia 94 imagery showing location of M-class flare from an active region nearing limb in the northeast quadrant of the visible disc.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

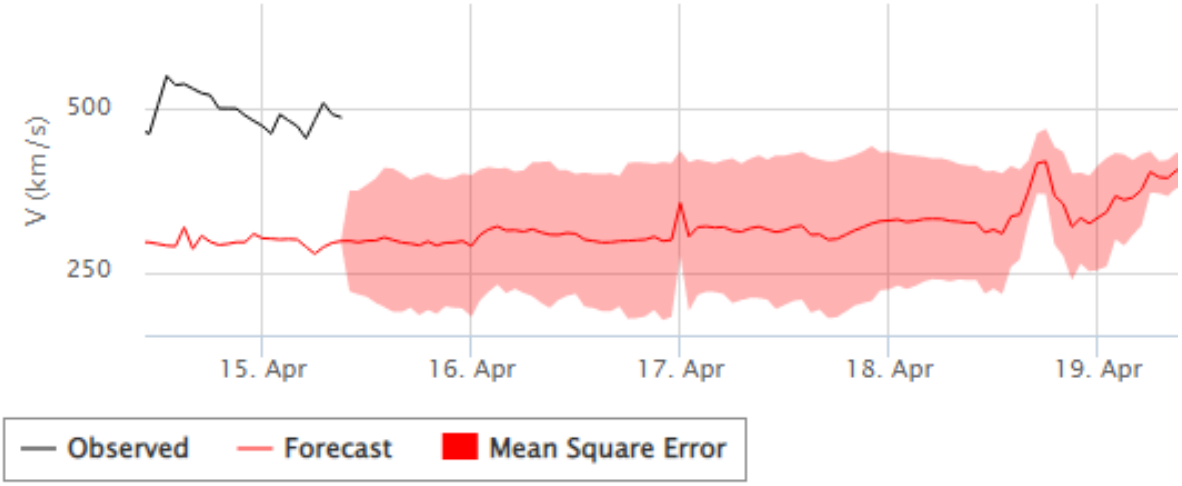
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background and in the absence of complex sunspots on the Earth-facing disc is expected to remain at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Met Office Solar Winds Prediction Model (SWPM), which has not resolved the CME from yesterday or the anticipated HSS due later tomorrow (16 April).



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

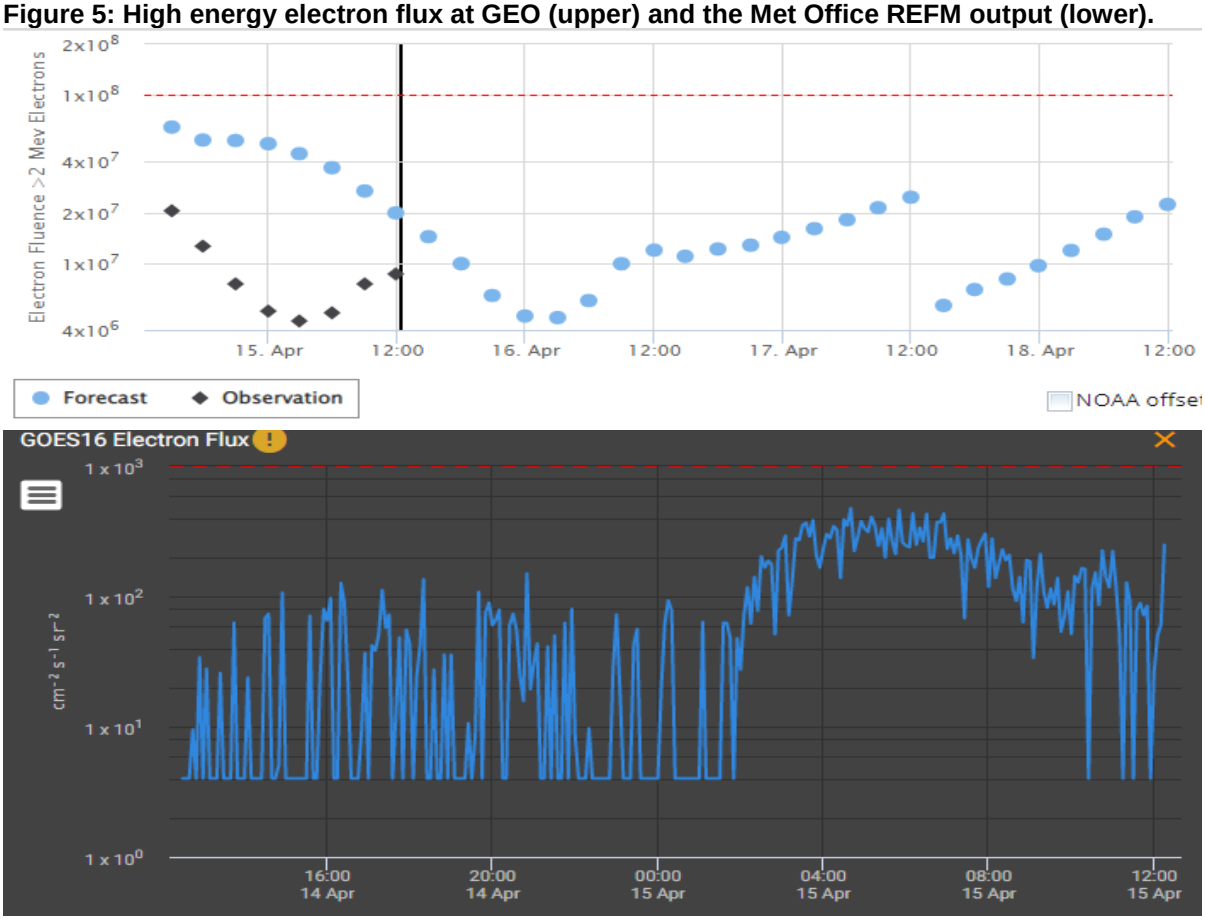
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 at GEO temporarily dropped out due to recent CME arrival, however the slight elevated to elevated solar wind environment has increased activity once more in the Van Allen belts resulting in the observed flux at GEO to rise to Moderate. There is a potential for it peaking at High levels on day 2 (16th). A further drop out in values is then likely later day 2 (16th), with the arrival of the fast wind of CH74, although this is low confidence in both timing and strength. A notable flux enhancement from this feature is currently considered unlikely, due to its unfavoured polarity, limited expected geomagnetic response, and the features relative immaturity with being new for this solar rotation.

The associated 24 hour electron fluence is likely to remain below the Active threshold throughout, but with a chance of approaching the active threshold by day 4 (18th). REFM is not giving good guidance at this stage and activity is likely to be higher at times than indicated.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	20	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux at GEO (upper) and the Met Office REFM output (lower).



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.